

PRELIMINARY ASSESSMENT REPORT

FOR

JACKPILE-PAGUATE URANIUM MINE
SR 279, NEAR PAGUATE, LAGUNA PUEBLO
PAGUATE, CIBOLA COUNTY, NEW MEXICO

Prepared for

U.S. ENVIRONMENTAL PROTECTION AGENCY
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EXECUTIVE SUMMARY

Weston Solutions, Inc. (WESTON®) has prepared this Preliminary Assessment (PA) Report to provide the U.S. Environmental Protection Agency (EPA) Region 6 with the results of the site reconnaissance and background investigation performed at the Jackpile-Paguate Uranium Mine (Jackpile-Paguate) site in Paguate, Cibola County, New Mexico.

The PA is intended to be a screening investigation of the site. The Scope of Work (SOW) is centered on characterizing the site through completing limited site-related research and site reconnaissance. START-3 completed the following tasks as part of this assessment:

- Performed an on-site reconnaissance to document current site conditions and to identify potential sources of hazardous substances at the site. As part of the reconnaissance, a survey of the site vicinity was completed to identify potential receptors or targets of hazardous substance migration and exposure attributable to the site.
- Prepared a Health and Safety Plan (HASP) prior to reconnaissance activities.
- Reviewed available reports, past and present waste handling practices, and permit history and historical data about the site.
- Obtained information documenting the environmental setting of the areas of concern to characterize the groundwater, surface water, soil exposure, and air pathways.
- Reviewed available regulatory compliance files from federal, state, and local government agencies.
- Evaluated available information from the on-site observations, historical aerial photographs, property ownership records, interviews, area environmental information, and area demographic characteristics.
- Entered available information into HRS Quickscore software to determine if the site is likely to receive a score of 28.50 or above under the HRS, potentially making it a candidate for placement on the NPL (Appendix A).
- Prepared this PA report presenting the findings of the investigation.

Based on the results of this assessment, the following is concluded:

- The uranium mine was identified as the sole source on-site.
- Previous sampling of groundwater wells revealed analytical results that contained fluoride, lead, arsenic, gross alpha, uranium, and Radium-226 above EPA MCLs. The closest drinking water well identified was 2.492 miles north of the site. All other nearby

wells were identified to the north. Groundwater flow from the site is to the south-southwest.

- Previous sampling of the surface water pathway revealed analytical results that contained gross alpha and uranium above EPA MCLs and manganese above secondary drinking water standards. There is no overland flow segment from the source to the in-water segments. The Rio Moquino and Rio Paguate bisect the mine and are in direct contact with the source. A fishery has been identified within the surface water pathway and the surface water pathway has resource use. Based on this information, further evaluation of the surface water pathway appears to be warranted.
- Releases of hazardous substances to the soil and air pathways have not been documented. A release to soil and air is thought to be of minor concern because of the lack of identified targets.

This report was prepared as part of the requirements of the Technical direction Document (TDD) No. TO-0019-09-10-01 and serves as documentation of work completed to date.

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The EPA Site Assessment Manager did not provide final approval of this report prior to the completion date of the work assignment. Therefore, Weston Solutions, Inc. has submitted this report absent the Site Assessment Manager's approval.

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1.0 INTRODUCTION

1.1 PURPOSE

Weston Solutions, Inc. (WESTON®) has prepared this Preliminary Assessment (PA) Report to provide the U.S. Environmental Protection Agency (EPA) Region 6 with the results of the site reconnaissance and background investigation performed at the Jackpile-Paguate Uranium Mine (Jackpile-Paguate) site in Paguate, Cibola County, New Mexico. A Resource Conservation and Recovery Act Information System (RCRIS) and Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Information System (CERCLIS) identification number of NMN000607033 has been assigned to this site. WESTON was tasked under the Superfund Technical Assessment and Response Team (START-3) Contract Number EP-W-06-042 to perform this PA under Technical Direction Document (TDD) number TO-0019-09-10-01 (Appendix B). The information presented in this report is based on a site reconnaissance conducted on 17 and 18 February 2010, a review of previous reports, a review of aerial photographs, a review of site regulatory compliance history, a review of historical data, and interviews with Pueblo of Laguna Environmental Program officials.

1.2 OBJECTIVES OF THE INVESTIGATION

The PA is a screening investigation in a series of site assessments that the EPA may complete at a known or potential hazardous waste site being investigated under CERCLA prior to its possible inclusion on the National Priorities List (NPL). A PA is a limited scope investigation that distinguishes sites that pose little or no threat to human health and the environment and sites that require further investigation. The primary objectives of this PA were the following:

- Identify Hazardous Waste Source Areas (HWSAs) at the site in an attempt to document the presence of hazardous substances at the site. Evaluate the potential threat that migration or exposure of the hazardous substances from the site may pose.
- Collect information that can be used to assess the site using EPA Hazard Ranking System (HRS) to help determine whether further investigation of the site under CERCLA is warranted to pursue listing of the site on the NPL (Reference 1).

To accomplish these objectives, START-3 conducted a site reconnaissance visit on 17 and 18 February 2010. During the site reconnaissance, START-3 visited the site, visually observed the

property features and conditions, recorded observations in a logbook, and met with Pueblo Laguna Environmental Program representatives. EPA Region 6 representatives Brenda Cook, Site Assessment Manager (SAM); LaDonna Turner, SAM; and Stephen Harper; and Agency for Toxic Substances and Disease Registry (ASTDR) Representative Patrick Young were present at the time of the site visit (Reference 6).

1.3 SCOPE OF WORK

The PA is intended to be a screening investigation of the site. The Scope of Work (SOW) is centered on characterizing the site through completing limited site-related research and site reconnaissance. START-3 completed the following tasks as part of this assessment:

- Performed an on-site reconnaissance to document current site conditions and to identify potential sources of hazardous substances at the site. As part of the reconnaissance, a survey of the site vicinity was completed to identify potential receptors or targets, of hazardous substance migration and exposure attributable to the site.
- Prepared a Health and Safety Plan (HASP) prior to reconnaissance activities.
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- Entered available information into HRS Quickscore software to determine if the site is likely to receive a score of 28.50 or above under the HRS, potentially making it a candidate for placement on the NPL (Appendix A).
- Prepared this PA report presenting the findings of the investigation.

1.4 REPORT FORMAT

The PA report is presented in a format that is intended to facilitate evaluation of the site using the HRS. The report contains the following sections:

- Section 1 – Introduction
- Section 2 – Site Characteristics
- Section 3 – Groundwater Pathway
- Section 4 – Surface Water Pathway
- Section 5 – Soil Exposure
- Section 6 – Air Pathway
- Section 7 – Conclusions
- Section 8 – Reference List

The references follow the text of the report and provide additional information. Tables are attached at the end of the sections in which they are first cited. The figures and appendices are provided as separate portable document format (PDF) files.

2.0 SITE CHARACTERISTICS

START-3 collected and reviewed available information regarding the site location, property ownership, site description, nearby land use, site operational history, and regulatory compliance history. This site background information is summarized in this section.

2.1 SITE LOCATION

The Jackpile-Paguate site is located on the Laguna Indian Reservation about 40 miles west of Albuquerque in Paguate, Cibola County, New Mexico (Reference 2, Reference 3). The site is located at Latitude 35° 8' 16.74" North and Longitude 107° 20' 51.84" West. Latitude and Longitude coordinates were measured from the approximate center of the former mine and were determined using a scaled aerial photograph and ESRI geographical information system (GIS) ArcMap Software. The site is located in an area of canyons and arroyos to the east of the village of Paguate and can be reached by taking SR 124 off of interstate 40, 1.7 miles west, than turning right or north on SR 279 and continuing approximately 6.5 miles. A Site Location Map derived from the GIS StreetMap United States of America Software, 2003 is included as Figure 2-1.

The town of Paguate is located adjacent and west of the site with a population of approximately 492 according to the 2000 census (Reference 5).

2.2 SITE DESCRIPTION

The property on which the former uranium mine is located is approximately 7,868 acres in size. Approximately 2,656 acres of this property were disturbed and contained three open pits that were between 200 and 300 feet deep; 32 waste dumps; and 33 protore stockpiles (Reference 3, Reference 4).

The remaining surrounding area is mainly undeveloped and consists of a varied topography containing wildlife consisting of elk, antelope, goats, and mule deer, and approximately 1,500 domesticated cattle are grazed on the Laguna Reservation (Reference 6). The perennial rivers Rio Moquino and Rio Paguate bisect the site near its center. The Rio Moquino flows southeasterly into the Rio Paguate within the site, and the Rio Paguate continues to flow south of the site through the

Paguate Reservoir and then becomes the Rio San Jose (Reference 2). Site features are shown in Figure 2-2.

The area surrounding the site was examined to identify potential receptors or targets of hazardous substance migration from the site. Nearby land use and potential alternative source sites also were documented. Observations from the site reconnaissance were as follows:

- The site is within the Laguna Indian Reservation, in a rural location with a small number of residential properties in the surrounding vicinity.
- Livestock were observed in the area drinking from the Rio Paguate.
- No stained soils were observed.

2.3 OPERATIONAL AND REGULATORY COMPLIANCE HISTORY

The Jackpile-Paguate Uranium Mine was operated by Anaconda Minerals Company, a division of Atlantic Richfield Company. Mining operations were conducted from 1953 through 31 March 1982. The mine was closed because of depressed uranium mining conditions. During the 29 years of mining, approximately 400 million tons of rocks were moved within the mine area and approximately 25 million tons of uranium ore were transported via the Santa Fe Railroad from the mine to Anaconda's Bluewater Mill, approximately 40 miles west of the site (Reference 3, Reference 4).

In December 1986, under a series of agreements between the Bureau of Indian Affairs (BIA) and the Pueblo of Laguna, it was agreed that the Pueblo of Laguna would perform the management, coordination, and administration of the Jackpile-Paguate Reclamation Project in accordance with the requirements set forth in the Jackpile-Paguate Environmental Impact Statement (EIS) and the associated Record of Decision (ROD) (Reference 4).

Reclamation of the Jackpile-Paguate Uranium Mine commenced in 1990. The "preferred alternative" reclamation plan incorporated the following: backfilling the open pit areas to at least 10 feet above projected groundwater recovery levels using protore and waste rock dump material; reducing the upper 15 feet of highwall slopes; recontouring and covering remaining waste rock dumps; completing arroyo drainage improvements and erosion controls;

decontaminating those structures (such as the structures and facilities associated with P-10 Mine and New Shop) to remain; and removing/disposing of non-essential structures; plugging and bulkheading underground ventilation raises and decline portals, respectively; reclaiming of miscellaneous features such as wells, access roads, rail spurs, drill holes, etc.; performing site-wide revegetation of disturbed areas; and providing site security and long-term monitoring of reclamation success for a period of not less than 10 years (Reference 4).

On 10 June 1995, the Laguna Construction Company, who was in charge of the reclamation, officially closed out the Jackpile Reclamation Project (Reference 7).

In September 2007, a ROD Compliance Assessment for Jackpile-Paguate Uranium Mine was completed by OA Systems Corporation to determine if the post-reclamation had met the requirements of the EIS and ROD. This report concluded that reclamation of the mine was still not complete as several non-compliant and potentially non-compliant issues still needed to be addressed. The mine would be considered complete when revegetated sites reached 90 percent of the density, frequency, foliar cover, basal cover, and production of undisturbed reference areas (but no sooner than 10 years following seeding). In addition, gamma radiation levels were to be no greater than twice background over the entire mine site. Outdoor radon 222 concentrations were to be no greater than 3 picocuries per liter (pCi/L). Radon daughter levels (working levels {WL}) in any remaining surface facilities were not to exceed 0.03 WL (Reference 4).

2.4 POTENTIAL SOURCE OF HAZARDOUS SUBSTANCES

The potential source of hazardous substances identified at the site, based on available background information, is described in this section. One potential source of hazardous substances, the Uranium Mine, was identified at the site. The Uranium Mine, the potential source, is considered a “pile” source for HRS scoring purposes since it most closely fits that HRS source description (Reference 1). Mining operations at the Jackpile-Paguate Uranium Mine resulted in 2,656 acres of surface disturbance (Reference 3). The surface disturbance was as follows:

Features	Acres Disturbed
Open Pits	1,015
Waste Dumps	1,266
Protore Stockpiles	103
Topsoil Stockpiles	32
Support Facilities and Depleted Ore Stockpiles	240
TOTAL	2,656

During the later years of mining, some overburden was placed into the mined-out portions of the pits. The southern portion of the Jackpile Pit and the South Paguate Pit received most of this material. There were no requirements to keep records on the radiological content of the backfill material (Reference 3).

Approximately 23 million tons of uranium resources remain at the mine site as stockpiled protore and unmined deposits. Protore is material that was stockpiled throughout the mining operation because it contains elevated but sub-economic uranium concentrations (Reference 3). Approximately 21 million tons of protore, containing 0.02 to 0.059 percent uranium (U-308) exist at the mine site. This material is located on the surface in 23 stockpiles dispersed throughout the mine. Approximately 2 million tons of unmined deposits containing 0.094 to 0.30 percent uranium (U308) remain at the site. These resources are located in 11 deposits, 3 of which contain 90 percent of the resources (Reference 3).

As stated above, the wastes generated at Jackpile-Paguate Uranium Mine were not removed from the site but used for backfill. There was no impermeable cap placed on top of the backfill other than 3 feet of overburden (material removed during surface mining and stockpiled) and 2 feet of topsoil (Reference 3, Reference 4).

3.0 GROUNDWATER PATHWAY

A discussion of the groundwater migration pathway is provided in this section. The discussion focuses on the aquifer characteristics of the region, the likelihood of a release to groundwater, and the potential targets of hazardous substance migration through the groundwater pathway. The section is formatted to facilitate identification of the criteria that EPA uses to evaluate sites under the HRS.

3.1 HYDROGEOLOGIC SETTING

The following subsections discuss the aquifer characteristics the underlay the Jackpile-Paguate Uranium Mine site.

3.1.1 Geologic Framework

The Jackpile-Paguate site is located in mesa and canyon country typical of much of the southeastern Colorado Plateau. It is situated in a broad valley of northwest-dipping, sandstone-capped benches pierced by numerous basaltic volcanic necks that rise up to 1,000 feet above the surrounding terrain (Reference 3).

Sedimentary rocks exposed in the area of the site range in age from late Triassic to Late Cretaceous. In addition, Tertiary age diabase dikes and sills and volcanic flow rocks are exposed near the site (Reference 3).

At the site, all of the rock units above the lower Mancos Shale have been eroded. The stratigraphy of the mine includes the Morrison Formation, Dakota Sandstone, Mancos Shale, Tertiary igneous dikes and Quaternary alluvium (Reference 3).

3.1.2 Groundwater Conditions

The Jackpile-Paguate Uranium Mine site and surrounding area is underlain by the Alluvium and Jackpile Sandstone Aquifers.

The Alluvium Aquifer is a shallow aquifer and ranges in thickness from 0 to 60 feet thick along the Rios Paguate and Moquino, and it is over 100 feet thick along the Rio San Jose (Reference 3). The yield ranges from 15 to 90 gallons per minute (gpm). The water from this aquifer is enriched in calcium and magnesium and contains high concentrations of dissolved solids. The water in this aquifer consists of a mixture of surface water from Rio Moquino and Rio Paguate.

The Jackpile Sandstone of the Morrison Formation ranges in thickness from 0 to 230 feet. The Jackpile Sandstone Aquifer dips to the north-northwest at about one degree through the Jackpile-Paguate Mine area (Reference 8). The typical groundwater contained in the Jackpile Sandstone is a sodium sulfate bicarbonate type, and, less frequently, a sodium bicarbonate sulfate type (Reference 3). The Jackpile Sandstone aquifer is isolated hydraulically from other water-containing units by shales and mudstones, above and below. Pumping hydrologic test wells show that the Jackpile Sandstone Aquifer yields in the range of less than 1 gpm to about 10 gpm. The Jackpile Sandstone is a poor aquifer of extremely limited potential for use (Reference 8).

Recharge to the Jackpile Sandstone Aquifer occurs primarily southwest of the mine, along the upper Rio Paguate, and to a lesser extent, along the Rio Moquino and Arroyo Padilla. Discharge from the Jackpile Sandstone occurs to the Rio Paguate in the vicinity of its confluence with the Rio Moquino and to a minor extent the upper portion of Oak Canyon (Reference 8).

3.2 LIKELIHOOD OF RELEASE

Groundwater sampling or other subsurface investigations were not performed as part of this assessment. The likelihood of a chemical release to the groundwater pathway depends on factors such as the depth to groundwater, depth of contamination, net precipitation, thickness of impermeable layers, and hydraulic conductivity of the subsurface. These factors are described below.

3.2.1 Depth to Groundwater

Seven monitoring wells were installed within and around the Jackpile-Paguate Uranium Mine by the Jacobs Environmental Monitoring Plan as part of the ROD Compliance Assessment to monitor post-reclamation water quality. Three of these wells were completed within the Jackpile Sandstone

Aquifer to depths ranging from 231 to 375 feet below ground surface (bgs) and four of these wells were completed in the Alluvium Aquifer at 40 to 60 feet bgs (Reference 4). Based on the total depths of the seven on-site monitoring wells, the depth to the most shallow groundwater zone at the site is approximately 40 feet bgs.

3.2.2 Depth of Contamination

The depth of contamination at the site is not known as a subsurface investigation has not been performed. Analytical results from previous investigations discussed in Subsection 3.2.6 reveal contamination within on-site monitoring wells screened between 40 and 375 feet bgs (Reference 4).

3.2.3 Net Precipitation

The average annual precipitation for the City of Laguna, just outside of Paguate, is approximately 9.5 inches based on information from the World Climate website. The net precipitation factor value for Cibola County is approximately 1 based on the Figure 3-2 found in the HRS Rule (Reference 1).

3.2.4 Thickness of Impermeable Layers

No subsurface investigations have been performed, and the presence of an impermeable layer that would limit contaminants from migrating to the shallow groundwater-bearing zone is not known.

3.2.5 Hydraulic Conductivity of Impermeable Layers

Although no impermeable layer has been identified the hydraulic conductivities of the groundwater bearing units are about 22 feet per day for the undisturbed alluvium and 0.3 feet per day for the Jackpile Sandstone. Groundwater flow is most likely to the south-southwest (Reference 3).

3.2.6 Groundwater Analytical Results from Previous Investigations

As part of the monitoring requirements established through EIS and ROD, semi-annual and annual groundwater monitoring was to occur during reclamation and for 10 years thereafter. There were seven monitoring wells installed within and around the Jackpile-Paguate Uranium Mine to meet these requirements (Reference 4). The areas and depths of the wells are described as follows:

Monitoring Well	Location	Total Depth (feet)	Aquifer
MW-1	North of the Paguate Pit	231	Jackpile Sandstone
MW-2	Near the intersection of the south end of the site boundary and the Rio Paguate	40	Alluvium
MW-3	South of the Jackpile Pit offices and east of the Rio Paguate	60	Alluvium
MW-4	South of the Rio Paguate and north of the South Paguate Pit	50	Alluvium
MW-5	In Oak Canyon adjacent to the site boundary	262	Jackpile Sandstone
MW-6	Near the intersection of the south end of the site boundary and the Rio Paguate	60	Alluvium
MW-7	North of the Rio Paguate and west of the Rio Moquino near the confluence	375	Jackpile Sandstone

Groundwater data were evaluated for 10 years between 1997 and 2007. During this evaluation, several analytes were found to exceed EPA Maximum Contaminant Levels (MCLs) for drinking water and National Secondary Drinking Water Standards at most sampling locations (Reference 4). Parameters of concern over the 10 year period included the following:

Primary Standards (MCLs)

- Fluoride – Concentration exceeding 4 milligrams per liter (mg/L) were found in the 10 annual samples taken from MW-1.
- Lead – One exceedance of the standard of 0.015 mg/L was found in MW-1.
- Arsenic – One sample from MW-4 exceeded the standard of 0.01 mg/L.
- Gross Alpha – Samples from all 7 wells exceeded 15 pCi/L. These included (number of excursions are in parentheses): MW-1 (1), MW-2 (9), MW-3 (6), MW-4 (9), MW-5 (3), MW-6 (8), and MW-7 (4).
- Uranium – Samples from the 7 wells exceeded the MCL of 0.03 mg/L. These included (number of exceedances are in parentheses): MW-1 (1), MW-2 (9), MW-3 (8), MW-4 (9), MW-5 (3), MW-6 (9), and MW-7 (4).
- Radium-226 – Samples from 2 wells exceeded the standard of 5 pCi/L. These included (number of exceedances are in parentheses): MW-1 (1), MW-6 (1), MW-7 (4).

Secondary Standards (National Drinking Water Standards)

- Total Dissolved Solids (TDS) – the secondary standard of 500 mg/L was exceeded in all 7 wells.
- Sulfate – the secondary standard of 250 mg/L was exceeded in all 7 wells.
- Manganese – samples from 3 wells exceeded the secondary standard of 0.05 mg/L. These include (number of exceedances are in parentheses): MW-2 (10), MW-3 (3), MW-6 (7).

3.3 GROUNDWATER PATHWAY TARGETS

The potential receptors, or targets, of the groundwater pathway include the population and resources that rely on local aquifers as a source of water supply. The potential groundwater pathway targets for the site are discussed below.

3.3.1 Nearest Well

According to the Water Well Report provided by GeoSearch, the nearest domestic well is located 2.492 miles north of the Jackpile-Paguate Uranium Mine site (Reference 10).

3.3.2 Other Nearby Wells

GeoSearch identified a total of 11 groundwater wells within a 4-mile radius of the site: Water from these wells was used for the following purposes:

- Domestic use (2 wells)
- Monitoring wells (3 wells)
- Water for mining, milling or oil (5 wells)
- Sanitary in conjunction with commercial use (1 well)

GeoSearch conducted the water well search using the United States Geological National Water Information System, and the Water Administration Technical Engineering Resource System. (Reference 10) In addition, 7 monitoring wells were installed as part of the monitoring requirements established through the ROD (Reference 4). During the site reconnaissance visit on 17 and 18 February 2010, START-3 was informed of other wells within the vicinity of the site, but no information on these was available and there are no records of these wells within the federal or state databases searched. Identified wells located within a 4-mile radius of the

approximate site boundary are depicted in Figure 3-1.

3.3.3 Wellhead Protection Areas

No Wellhead Protection Areas (WHPA) have been identified within 4 miles of the site.

3.3.4 Groundwater Resources

Groundwater from the Alluvium and Jackpile Sandstone Aquifers are used for irrigation and livestock purposes. (Reference 3)

3.4 GROUNDWATER PATHWAY CONCLUSIONS

START-3 did not observe any visible releases of hazardous substances that could significantly impact groundwater during the 17 and 18 February 2010 site visit (Reference 6). However, analytical results from previous subsurface investigations of groundwater wells contained fluoride, lead, arsenic, gross alpha, uranium, and Radium-226 above EPA MCLs (Reference 4). Further sampling would be required to determine the lateral and vertical extent of contamination within the groundwater.

Remaining data gaps for the groundwater pathway include the following:

- Identification of Wellhead Protection Areas
- Determination of the thickness of the formations located at the site
- Depth of screened intervals of the on-site monitoring wells

4.0 SURFACE WATER PATHWAY

Surface water is the second of four pathways of potential hazardous waste migration assessed for the Jackpile-Paguate property. A discussion of the types of surface water drainage pathways at the site, the probable point of entry (PPE) for a hazardous substance from the site to enter surface water, the likelihood of a release, and the potential targets of the hazardous substance migration are discussed in this section.

4.1 HYDROLOGIC SETTING

On a more local scale, surface water at the site includes the overland flow path, in water segments of the Rio Moquino and Rio Paguate on site, the PPE, and the downstream surface water flow path. These pathway segments are described in the following subsections.

4.1.1 Overland Flow Segment

There is no overland flow segment from the source to the in-water segments. The Rio Moquino and Rio Paguate bisect the mine and are in direct contact with the source (Reference 2, Reference 8). Within the mine footprint, groundwater in the Jackpile Sandstone Aquifer interchanges with water in the Rio Moquino and Rio Paguate through the unconsolidated alluvium deposits along the perennial river channels. The stream deposits act as a mixing zone between the surface water in the rivers and the groundwater discharging from the underlying Jackpile Sandstone Aquifer (Reference 8).

4.1.2 Probable Point of Entry

The PPE is the estimated point at which the overland flow segment leading from the source area reaches a perennial surface water body. The PPE for the Jackpile-Paguate site is where the Rio Paguate and Rio Moquino bisect the mine and are in direct contact with the source, exits the mine property and continues to flow south. The PPE location is shown in Figure 2-2. From the PPE, Rio Paguate flows south approximately 5.5 miles before entering the Paguate Reservoir. The Paguate Reservoir is approximately 0.5 miles long, and then the Rio Paguate continues an additional 0.6

miles before converging with and becoming the Rio San Jose. The Rio San Jose continues for the remaining 15-mile Target Distance Limit (TDL) (Reference 2). The flow path of the surface water from the PPE to a point 15 miles downstream is summarized in Table 4-1 and illustrated in Figure 4-1.

4.2 LIKELIHOOD OF RELEASE

Based on available information, releases to the surface water pathway may have occurred on-site, because the source is located directly upgradient of the PPE. Factors affecting the likelihood of release are described below.

4.2.1 Distance to Surface Water

The shortest distance from the source area to a perennial surface water body is 0 feet, with the Rio Paguate bisecting the mine and in direct contact with the source (Reference 3).

4.2.2 Flood Frequency

No Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map exists within the Laguna Indian Reservation, New Mexico. For the purpose of this assessment and based on another FEMA map of a nearby area within the county, the majority of the Jackpile-Paguate site is located outside of the 500-year floodplain, although the areas adjacent to Rio Moquino and Rio Paguate are within Zone A of the FEMA Flood Insurance Rate Map. Zone A is defined as a high-risk area having a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year mortgage (Reference 11).

4.2.3 2-Year, 24-Hour Rainfall

The 2-year, 24-hour rainfall for Cibola County is approximately 1.5 inches (Reference 12).

4.2.4 Flood Containment

Based on observations during the 17 and 18 February 2010 site visit, the potential hazardous substance source area at the site has no containment features that would prevent or contain a release if source becomes flooded (Reference 6).

4.2.5 Surface Water Analytical Results from Previous Investigations

As part of a ROD Compliance Assessment, surface water data at the site were evaluated for 10 years between 1997 and 2007 (Reference 4). During this evaluation, several samples were found to exceed EPA MCLs for drinking water for gross alpha radiation particles at 15 pCi/L and total uranium at 0.03 mg/L and National Secondary Drinking Water Standards of 0.05 mg/L for manganese. The following concentration ranges were found in samples collected during the 10 year ROD compliance timeframe:

Location	Gross Alpha Radiation Concentrations pCi/L	Total Uranium Concentrations mg/L	Manganese Concentrations mg/L
Rio Paguate – Ford Crossing-Rail Trestle	37.9 - 214.33	0.08 - 544.14	<0.01 - 10.7
Lower Rio Moquino	5.24 - 53.05	0.03 - 234.95	0.0 - 0.127
Lower Rio Paguate	2.24 - 106.22	0.016 - 149.62	0.0357 - 0.13
Paguate-Moquino Confluence	[-21.98 ¹] - 94.03	0.029 - 252.59	0.0112 - 0.14
Upper Rio Moquino	[-12.46 ¹] - 35.11	0.008 - 52.89	<0.01 - 0.036
Upper Rio Paguate	ND - 25.53	0.002 - 32.21	0.0396 - 0.146
Paguate Reservoir	ND - 3.04	0.002 - 17.42	<0.01 - 0.004

Notes:

¹ Negative counts [] may occur since sample counts are compared to background counts, and background counts reflect naturally occurring radionuclides and cosmic radiation that are detected by laboratory instrumentation. Samples that are not different from background may have a negative value when background is subtracted (Reference 13).

ND – Not Detected.

< - Less Than.

As part of the Water Pollution Program Grants (Section 106), the Pueblo of Laguna Environmental and Natural Resources Department has been collecting surface water samples along the surface water pathway quarterly from 2005 through 2009. The samples have been analyzed for isotopic uranium and total uranium (Reference 14). As with the samples collected as part of the ROD Compliance Assessment, these samples also contain uranium concentrations that exceed the EPA MCL of 0.03 mg/L or 30 micrograms per liter (ug/L). The following uranium concentration ranges

were found in the samples collected:

Location	Total Uranium Concentrations ug/L	U-234 Concentrations ug/L	U-235 Concentrations ug/L	U-238 Concentrations ug/L
RPG-03 Rio Paguate below the former Jackpile mine (at the PPE)	0.007 - 425.557	0.004 - 92.667	[-0.032 ¹] - 4.72	0.003 - 448
RPG-04 Rio Paguate at Mesita Dam (within the TDL)	0.008 - 36.533	0.008 - 72.939	[-0.008 ¹] - 2.208	0.039 - 216
RSJ-04 Rio San Jose below the Dipping Vat Spring on Sedillo Grant (beyond the TDL)	2.012 - 21.615	0.001 - 9.435	0.043 - 0.547	0.675 - 14.6
RMQ-01 Rio Moquino above Jackpile mine (background)	0.005 - 31.138	0.000 - 5.972	0.000 - 1.177	0.005 - 30.904

Notes:

¹ Negative counts [] may occur since sample counts are compared to background counts, and background counts reflect naturally occurring radionuclides and cosmic radiation that are detected by laboratory instrumentation. Samples that are not different from background may have a negative value when background is subtracted (Reference 13).

4.3 SURFACE WATER PATHWAY TARGETS

The potential targets of the surface water pathway include the population relying on surface water downstream of the PPE as a source of drinking water, as well as downstream fisheries, sensitive environments and surface water resources. The targets identified within the surface water pathways are discussed in the following sections.

4.3.1 Drinking Water Intakes

No surface water intakes are present within the 15-mile TDL. Water for drinking purposes in the county is provided by groundwater. The Village of Paguate obtains water from two wells located in

the alluvium of the Rio Paguate upstream from the mine site (Reference 3).

4.3.2 Wetlands and Other Sensitive Environments

No U. S. Department of Interior Wetland Inventory Map is available for Cibola County. According to the New Mexico Ecological Services Field Office, there are 8 species of birds, 2 species of fish, 2 species of mammals, 1 anthropod-invertebrate, and 5 plants on the listed and sensitive species list for Cibola County (Reference 15).

4.3.3 Fisheries

No commercial fisheries have been identified within the surface water pathway. However, recreational fishing does occur and has been documented within the Rio Paguate, the Paguate Reservoir, and the Rio San Jose. According to the Pueblo of Laguna Environmental and Natural Resources Department, Rio Paguate, Paguate Reservoir and Rio San Jose are fished for catfish, bluegill, and crappie that are caught for human consumption within the 15-mile TDL (Reference 16).

4.3.4 Surface Water Resources

Surface waters from the Rio Paguate and Rio Moquino are used for irrigation upstream from the villages of Paguate and Seboyeta, respectively. Surface water from the Rio Paguate below the Jackpile-Paguate Mine site is also used for irrigation by the Village of Mesita. Surface water is also consumed by livestock from the Paguate Reservoir and along the Rio Paguate between the reservoir and the mine site at points of access (Reference 3). The Rio Paguate's designated uses include cold water aquatic life, domestic water supply, fish culture, irrigation, livestock watering, wildlife habitat, and primary contact according to the EPA (Reference 17).

4.4 SURFACE WATER PATHWAY CONCLUSIONS

The potential source of hazardous constituents at the Jackpile-Paguate site is neither covered nor contained. Evidence of surface water contamination has been observed through analytical results from previous investigations of the site. Analytical results contained gross alpha radiation particles and total uranium concentrations above EPA MCLs and manganese concentrations above

Secondary Drinking Water Standards (Reference 4, Reference 14).

Data gaps for the surface water pathway include the following:

- Documentation of recreational fishing in the downstream rivers and reservoirs.
- Specific location of wetlands and endangered species along the surface water pathway.
- Additional surface water sampling to determine extent of contamination and if this contamination meets observed release criteria as defined by the HRS (Reference. 1).

Table 4-1
Surface Water Pathway Summary
Jackpile-Paguate Uranium Mine
Paguate, Cibola County, New Mexico

Distance Downstream from the PPE (miles)	Surface Water Body	Estimated Flow Rate (ft³/second)
0 (PPE) to 5 miles	Rio Paguate	1.29*
5.5 to 6 miles	Paguate Reservoir	Unknown
6 to 6.7 miles	Rio Paguate	Unknown
6.7 to 15 miles	Rio San Jose	51.7*

* Sources: Reference 8
 Reference 18

5.0 SOIL EXPOSURE

Direct contact with contaminated soil is another possible route of exposure to potential hazardous substances that may exist at the Jackpile-Paguate site. The discussion in this section focuses on soil exposure pathway factors including soil type, area of contamination, accessibility and the likelihood of exposure, and the potential targets.

5.1 SURFICIAL CONDITIONS

The Jackpile-Paguate site is located in an area of Cibola County that is generally characterized by Penistaja-San Mateo-Sparank soils. Penistaja-San Mateo-Sparank soils are deep soils, mainly on cuestas, fan terraces, flood plains, and alluvial fans. The mine is within a Dumps-Pits complex. This unit is on hills and flats. Slope is 5 to 90 percent. Areas are irregular in shape and are 200 to 1,000 acres in size. The unit is essentially barren of vegetation. Elevation is 6,000 to 7,500 feet. The unit is 50 percent Dumps and 35 percent Pits. Dumps occur in areas of waste rock, mine spoil (mainly uranium tailings), and other refuse. Reaction ranges from medium acid to very strong alkaline. Pits consist of open excavations from which soil material and some rocks have been removed (Reference 19).

No visual evidence of contaminated soil was observed during the PA site reconnaissance visit (Reference 6).

5.2 LIKELIHOOD OF EXPOSURE

Factors related to the likelihood of exposure to the area of suspected soil contamination or direct contact with another source of hazardous substances at the site is presented in the following sections.

5.2.1 Site Attractiveness and Accessibility

The attractiveness of the site for public use is believed to be low because the site is in a rural location. There is a fence and site security around the former mine. The site is not easily accessible by vehicle or by foot (Reference 4, Reference 6).

5.3 SOIL EXPOSURE TARGETS

Soil exposure targets are discussed in the following subsections.

5.3.1 Resident Population

The resident population includes persons living or working on areas of affected soil. No people are known to reside within the site boundaries of the Jackpile-Paguate Uranium Mine site.

5.3.2 Nearby Population

The nearby population includes those persons who live within 1 mile of areas of potential soil contamination attributable to the site. Those persons in houses, schools, or daycare facilities within 1 mile of the site may be considered part of the nearby population. The nearby population by distance ring was determined using the Geographic Correspondence Engine (MABLE/Geocorr2k) and is shown in Table 5-1. The MABLE/Geocorr2k application uses data based on the 2000 U.S. Census to determine the nearby population by distance (Reference 20). Based on this information, the nearby population within 4 miles of the site is approximately 500 persons.

5.3.3 Sensitive Environments

According to the New Mexico Ecological Services Field Office, there are 8 species of birds, 2 species of fish, 2 species of mammals, 1 anthropod-invertebrate, and 5 plants on the listed and sensitive species list for Cibola County (Reference 15).

5.3.4 Resources

Livestock was observed within the immediate vicinity of the site, and according to the Pueblo of Laguna there is a resident population of approximately 1,500 cattle on the Indian Reservation. The cattle are used for consumption (Reference 6). START-3 did not observe any part of the site or nearby land being used for commercial agriculture, or silviculture during the 17 and 18 February 2010 site visit.

5.4 SOIL EXPOSURE CONCLUSIONS

No visible evidence of soil contamination was observed during the 17 and 18 February 2010 START-3 site reconnaissance. No data was found for the site that addresses potential soil contamination. Soil exposure is not believed to be of large concern.

No data gaps relating to soil exposure have been identified.

Table 5-1
2000 U.S. Census Data - Block Level
Jackpile-Paguate Uranium Mine
Paguate, Cibola County, New Mexico

Site Coordinates	Population per Distance Interval							
	On-site	0 – 0.25 mile	0.25 – 0.5 mile	0.5 – 1 mile	1 – 2 miles	2 – 3 miles	3 – 4 miles	TOTAL
Latitude 35.11855 ° N Longitude 107.34508 ° W	0	0	0	0	0	420	80	500

Sources: START-3 site logbook (Reference 6)
MABLE/Geocorr2k Version 1.3.2
10/09 (Reference 20)

6.0 AIR PATHWAY

The discussion in this section of the report focuses on the air pathway, another potential route of hazardous substance migration from the site. Regional atmospheric conditions, the likelihood of a release to air, and potential air pathway targets are described.

6.1 METEOROLOGICAL CONDITIONS

The average annual precipitation for the City of Laguna, just outside of Paguate, is approximately 9.5 inches based on information from the World Climate website. The mean annual high temperature for Laguna is 69.8° F, and the mean annual low temperature is 37.8° F (Reference 21).

6.2 LIKELIHOOD OF RELEASE

The identified source does not have an impermeable cap, but does have 3 feet of overburden and 2 feet of topsoil on top of it (Reference 3, Reference 4). An observed release of hazardous substances from the site to the air pathway was not noted during reconnaissance activities. Quantitative air sampling was not completed as part of the PA.

6.3 AIR PATHWAY TARGETS

The population, resources, and sensitive environments within 4 miles of the site are potential targets of a release of hazardous constituents to the air pathway. The targets identified for the air pathway are discussed below.

6.3.1 Nearby Population

The nearby population by distance ring was determined using the Geographic Correspondence Engine (MABLE/Geocorr2k) and is shown in Table 5-1. The MABLE/Geocorr2k application uses data based on the 2000 U.S. Census to determine the nearby population by distance (Reference 15). Based on this information, the nearby population within 4 miles of the site is approximately 500 persons.

6.3.2 Sensitive Environments

Sensitive environments and resources have been identified previously in this report. Sensitive environments have been described in Subsection 3.3, Groundwater Pathway Targets; in Subsection 4.3, Surface Water Pathway Targets; and in Subsection 5.3, Soil Exposure Targets.

6.4 AIR PATHWAY CONCLUSIONS

A release of hazardous substances to the air pathway has not been documented. A release to air is thought to be of minor concern.

7.0 CONCLUSIONS

A PA was performed at the Jackpile-Paguate Uranium Mine site in Paguate, Cibola County, New Mexico to characterize potential sources of hazardous substances, to review background information relating to potential pathways of hazardous substance migration, and to determine pathway-specific receptors. Based on the results of this assessment, the following is concluded:

- The uranium mine was identified as the sole source on-site.
- Previous sampling of groundwater wells revealed analytical results that contained fluoride, lead, arsenic, gross alpha, uranium, and Radium-226 above EPA MCLs. The closest drinking water well identified was 2.492 miles north of the site. All other nearby wells were identified to the north. Groundwater flow from the site is to the south southwest.
- Previous sampling of the surface water pathway revealed analytical results that contained gross alpha and uranium above EPA MCLs and manganese above secondary drinking water standards. There is no overland flow segment from the source to the in-water segments. The Rio Moquino and Rio Paguate bisect the mine and are in direct contact with the source. A fishery has been identified within the surface water pathway and the surface water pathway has resource use. Based on this information, further evaluation of the surface water pathway appears to be warranted.
- Releases of hazardous substances to the soil and air pathways have not been documented. A release to soil and air is thought to be of minor concern because of the lack of identified targets.

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